Climate Change Summary, Padre Island National Seashore, Texas

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Climate Trends for the Area within Park Boundaries

- While average annual temperatures have increased across most of the world, the southeastern U.S. is an anomaly due to El Niño and other factors (Portmann et al. 2009). Average annual temperature in the park did not change significantly in the period 1950-2010 (Table 1, Figure 2).
- Average total precipitation increased substantially in the period 1950-2010, but the rate was not statistically significant (Table 1, Figure 2). Monthly precipitation showed statistically significant increases in March (+184 ± 71%) and July (+252 ± 118%).
- Although recent records suggest that climate change may have contributed to an increase in the intensity of North Atlantic hurricanes from 1970 to 2004, the Intergovernmental Panel on Climate Change (IPCC 2013) has concluded that changing historical methods, incomplete understanding of physical mechanisms, and tropical cyclone variability prevent direct attribution of hurricane changes to climate change.
- If the world does not reduce emissions from power plants, cars, and deforestation by 40-70%, models project substantial warming and changes in precipitation (Table 1, Figure 3).
- For projected average annual precipitation, the climate models do not agree, with over half projecting decreases, but some projecting increases (Figure 3).
- Under the highest emissions scenario, models project 20-40 more days per year with a maximum temperature >35ºC (95ºF.) by 2100 and an increase in 20-year storms (a storm with more precipitation than any other storm in 20 years) to once every 6-10 years (Walsh et al. 2014).

Published Historical Impacts in the Region

- Analyses of Audubon Christmas Bird Count data across the United States, including counts in Texas, detected a northward shift of winter ranges of a set of 254 bird species at an average rate of 0.5 ± 0.3 km per year from 1975 to 2004, attributable to human climate change and not other factors (La Sorte and Thompson 2007).
- Climate change has raised sea level globally and along the Texas coast (IPCC 2013). [See also NPS report from Maria Caffrey.]

Published Future Vulnerabilities in the Region

- Under all emissions scenarios, climate change would continue to raise sea level globally and along the Texas coast (IPCC 2013). [See also NPS report from Maria Caffrey.]
- Modeling of vegetation at Aransas Bay, north of the park, shows how sea level rise would inundate substantial areas of salty prairie grassland and evergreen forest ecosystems (March and Smith 2012).
- Under high emissions, the park will continue to be suitable habitat for Kemp's ridley sea turtle (*Lepidochelys kempii*) (Pike 2013).
- Under low and high emissions scenarios combined, increasing air and sand temperatures could reduce the hatching success of loggerhead sea turtles (*Caretta caretta*) up to 15% along Padre Island (Pike 2014).
- Population declines of the red knot (*Calidris canutus*), a migratory shorebird, may be related to climate change impacts on their food prey (Morrison et al. 2004, Baker et al. 2004)
- Beach driving causes sand-dune blowouts that render sand dune ecosystems more vulnerable to storm surge and sea level rise (Jewell et al. 2014).

Table 1. Historical rates of change per century and projected future changes in annual average temperature and annual total precipitation (data Daly et al. 2008, IPCC 2013; analysis Wang et al. in preparation). The table gives the historical rate of change per century calculated from data for the period 1950-2010. Because a rate of change per century is given, the absolute change for the 1950-2010 period will be approximately 60% of that rate. The table gives central values for the park as a whole. Figures 1-3 show the uncertainties.

	1950-2010	2000-2050	2000-2100
Historical			
temperature	0.1°C/century (0.2°F./century)		
precipitation	+35%/century		
Projected (compared to 1971-2000)			
Low emissions (IPCC RCP 4.5)			
temperature		+1.7°C (+3.1°F.)	+2.1°C (+3.8°F.)
precipitation		-1%	-1%
High emissions (IPCC RCP 6.0)			
temperature		+1.4°C (+2.5°F.)	+2.5°C (+4.5°F.)
precipitation		-1%	-4%
Highest emissions (IPCC RCP 8.5)			
temperature		+2.2°C (+4°F.)	+3.8°C (+6.8°F.)
precipitation		-2%	-2%

Figure 1. Historical annual average temperature for the area within park boundaries. Note that the U.S. weather station network was more stable for the period starting 1950 than for the period starting 1895. (Data: National Oceanic and Atmospheric Administration, Daly et al. 2008. Analysis: Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).

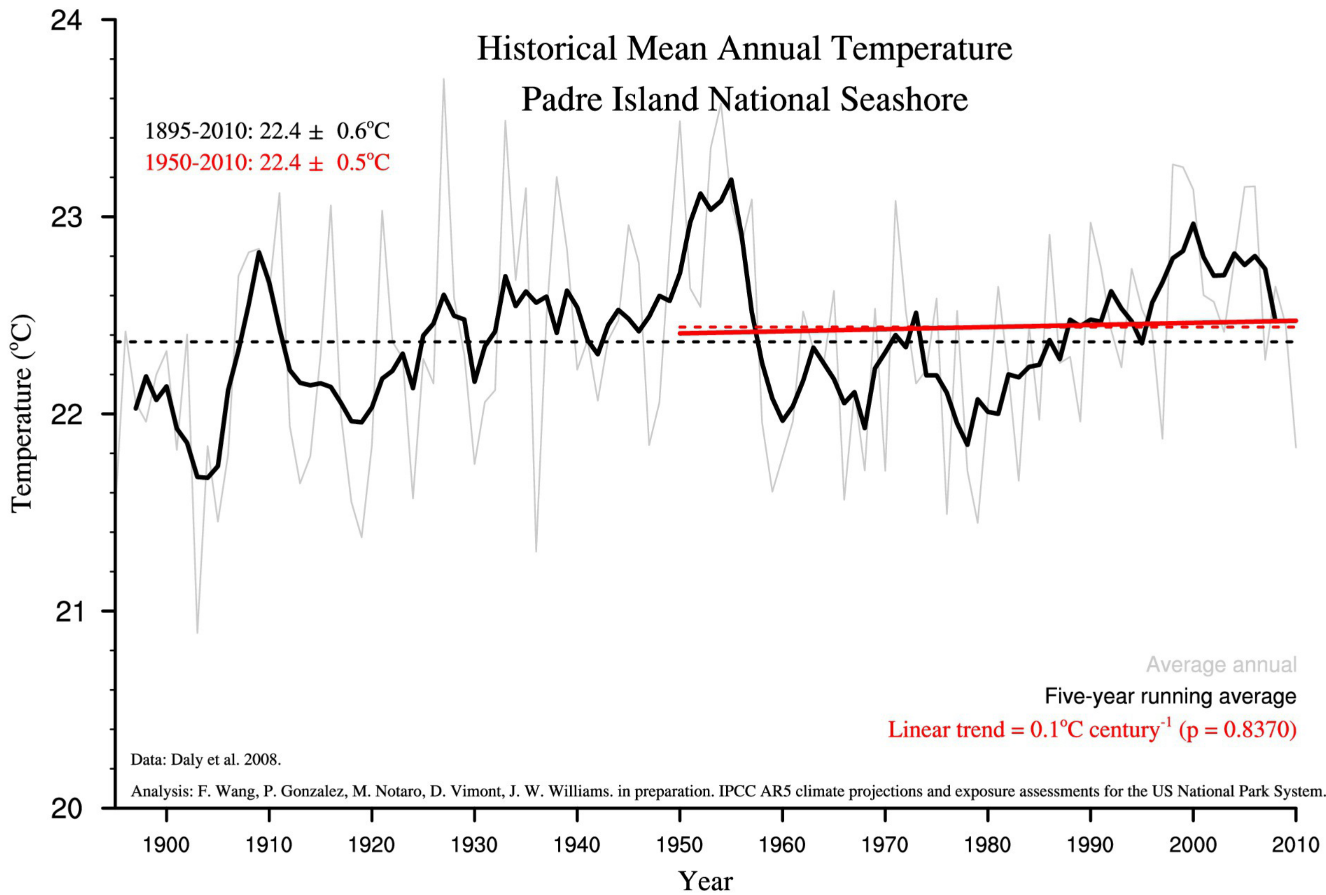


Figure 2. Historical annual total precipitation for the area within park boundaries. Note that the U.S. weather station network was more stable for the period starting 1950 than for the period starting 1895. (Data: National Oceanic and Atmospheric Administration, Daly et al. 2008. Analysis: Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).

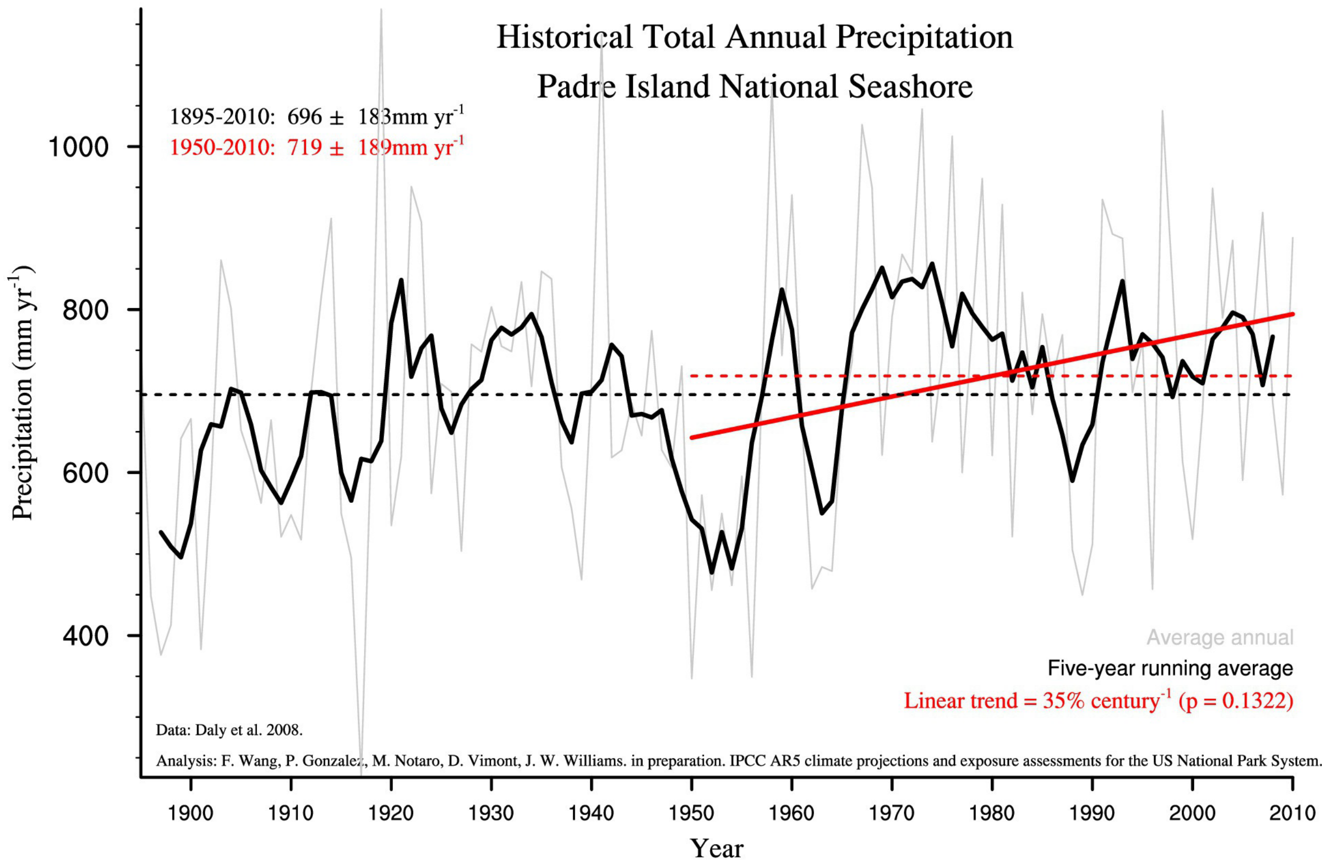
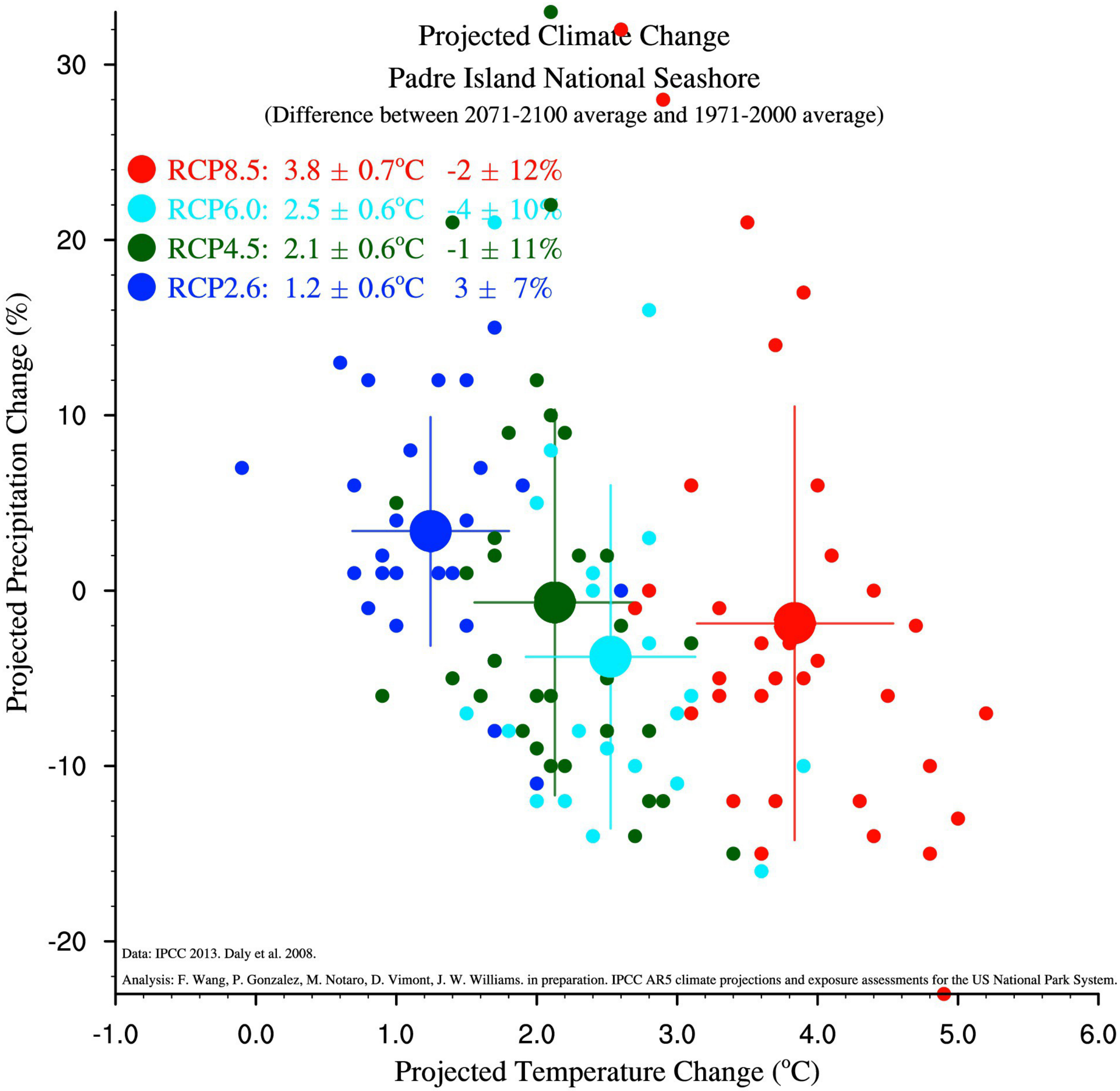


Figure 3. Projections of future climate for the area within park boundaries. Each small dot is the output of a single climate model. The large color dots are the average values for the four IPCC emissions scenarios. The lines are the standard deviations of each average value. (Data: IPCC 2013, Daly et al. 2008; Analysis: Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).



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